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Studies on the Egg Parasites of the Rice Grasshoppers, *Oxya japonica* WILLEMSE and *O. velox* FABRICIUS (VII)*

Especially on the Selection and the Finding of Host of the Egg parasites, *Scelio muraii* WATANABE and *S. tsuruokensis* WATANABE**

Sadaaki MURAI

(Laboratory of Applied Zoology, Faculty of Agriculture, Yamagata University)
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In the previous report, the author described that the females of both the species were capable to find the host eggs, though unexposed because she can get into the loose soil (MURAI, 1957b).

How in the sense did she select or find it ?

This paper deals with the functions of the selection and the finding of host of both the parasites.

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Materials and methods

The adults of both the species used in this experiment were obtained by protecting the *Oxya* eggs (pods) in the constant temperature air bath at 25℃ from March, 1957, and continually multiplied by providing unparasitized *Oxya* egg pods in the laboratory.

1) The selection of the host

From July to September, 1957, the author obtained the eggs (pods) of Acrididae insects, *i. e.*, *Parapleurus alliaceus* GERMAR, *Aiolopus japonicus* SHIRAKI, *Locusta migratoria danica* L., *Gastrimargus transversus* THUNBERG, *Oedaleus infernalis* DE SAUSSURE, *Sphingonotus japonicus* DE SAUSSURE, *Trilophidia velnerata* DE HAAN, *Oxya japonica* WILLEMSE, *O. velox* FABRICIUS and *Miramella mikado* BOLIVAR.

It is very interesting to know "What eggs are most infested by parasite ?"

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The author, therefore, had the investigations with the liberation of the parasites in a glass jar, in which is enclosed each insect egg pod.

On the other hand, the relation between an extent of the development of the host embryo and the selection of the parasites was investigated with the refrigerated *Oxya* eggs which are deposited by adults in the laboratory in October, 1956, and protected at 25℃. Those *Oxya* eggs were removed under the normal temperature as occasion calls and the development of embryo was quickened.

2) The finding of the host

The relation between the depth which laid the *Oxya* eggs (pods) under ground and the finding of the parasites was examined by liberation of the parasites in a glass jar of 12 cm in diameter and 19 cm in depth, in which is enclosed the soil and the *Oxya* eggs (pods). The treated egg pods were laid under ground of 1 cm and 2 cm in depth.

Moreover, as for the relation between the treated conditions of the eggs (pods) and the finding of the parasites, the unparasitized *Oxya* egg pods were wrapped in Japanese writing paper and the transparent paper, and one of those was also completely removed of the corky substance which enclosed the eggs (cf. Fig. 1).

The details of the experimental methods are given on each of such occasions.

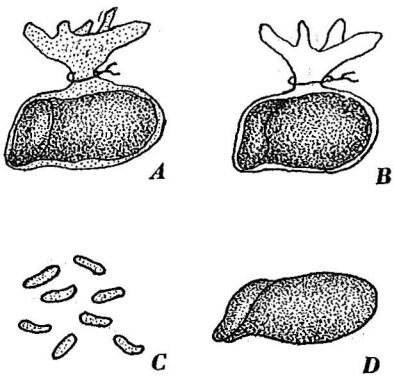

Fig. 1. Showing the treated conditions of the *Oxya* eggs (pods)
A : Wrapped in Japanese writing paper
B : Wrapped in transparent paper
C : Removed the corky substance
D : Non-treated

Results

1) The selection of the host of *Scelio muraii* and *S. tsuruokensis*

The selection of both the species against each insect egg (pod) was performed with the attacks of five parasites of each species per one pod.

The results are shown in Table 1.

Table 1

The selection of the host of *Scelio muraii* and *S. tsuruokensis* against each Acrididae egg (pod)

Species of Acrididae \ Item	Date of treated	Conditions of parasitism	
		Scelio muraii	*S. tsuruokensis*
Parapleurus alliaceus GERMAR	Sept. 23, 1957	Non-parasitism	Non-parasitism
Aiolopus japonicus SHIRAKI	Sept. 20, 1957	Non-parasitism	Non-parasitism
Locusta migratoria danica L.	Aug. 28, 1957	Non-parasitism	Non-parasitism
Gastrimargus transversus THUN.	Sept. 22, 1957	Non-parasitism	Non-parasitism
Oedaleus infernalis DE SAUSSURE	Sept. 22, 1957	Non-parasitism	Non-parasitism
Sphingonotus japonicus DE SAUSSURE	Sept. 18, 1957	Non-parasitism	Non-parasitism
Trilophidia velnerata DE HAAN	Sept. 18, 1957	Non-parasitism	Non-parasitism
Oxya japonica WILLEMSE	Aug. 28, 1957	Well-parasitism	Well-parasitism
O. velox FABRICIUS	Aug. 29, 1957	Well-parasitism	Well-parasitism
Miramella mikado BOLIVAR	Aug. 13, 1957	Non-parasitism	Non-parasitism

As is seen in Table 1, both the species harshly attacked the egg pods of genus *Oxya* and successfully completed the parasitism. But they paid no attention to the egg pods of the other Acrididae insects.

The results of the investigations on the relation between an extent of the development of host embryo and the selection of the parasites are shown in Table 2.

Table 2

The relation between an extent of the development of host embryo and the selection of *Scelio muraii* and *S. tsuruokensis*

Sp. \ Item	Extent of development of host embryo	Date of parasitized	Date of emerged	Duration	Temperature during the rearing (°C)		
					Max.	Min.	Av.
Scelio muraii	Early stage	July 15, 1957	Sept. 7, 1957	55	25.3	21.9	23.6
	Middle stage	July 11, 1957	Oct. 3, 1957	85	24.8	21.3	23.1
	Late stage	July 9, 1957	Oct. 20, 1957	104	23.7	19.9	21.8
	3 days before emergence	June 10, 1957	—	—	—	—	—
S. tsuruokensis	Early stage	Aug. 13, 1957	Sept. 24, 1957	43	25.2	21.5	23.4
	Middle stage	June 16, 1957	Aug. 29, 1957	75	25.3	22.0	23.7
	Late stage	July 23, 1957	Oct. 24, 1957	94	23.3	19.4	21.4
	3 days before emergence	June 13, 1957	—	—	—	—	—

Note : The temperature after parasitization was recorded with the self-recording thermometer.

As is seen in Table 2, the *Oxya* eggs in all stages of embryonal development except three days before emergence may be successfully parasitized by both the species and produced the progeny. But the duration, it seems, becomes prolonged as the embryonal development of the host eggs is advanced.

2) The finding of the host of *Scelio muraii* and *S. tsuruokensis*

As for the relation between the depth which laid host eggs (pods) under ground and the finding of the parasites, it was investigated with the liberation of the parasites in a glass jar, that is, 14 females of *Scelio muraii* and 20 females of *S. tsuruokensis* were liberated.

The results are shown in Table 3.

Table 3

The relation between the depth which laid host eggs (pods) under ground and the finding of *Scelio muraii* and *S. tsuruokensis*

Sp. \ Item	Depth	No. of treated egg pod	No. of parasitized egg pod	Rate of parasitized (%)	Date of do	Date of emerged	Temperature during the rearing (°C)		
							Max.	Min.	Av.
Scelio muraii	0 (Check)	7	7	100.0	July 27, 1957	Aug. 29, 1957	27.5	24.0	25.8
	1 cm	4	3	75.0	July 27, 1957	Sept. 24, 1957	25.6	22.0	23.8
	2 cm	3	0	0	—	—	—	—	—
S. tsuruokensis	0 (Check)	7	7	100.0	Aug. 14, 1957	Sept. 27, 1957	24.8	21.0	22.9
	1 cm	4	2	50.0	Aug. 29, 1957	Oct. 10, 1957	23.8	19.8	21.8
	2 cm	3	0	0	—	—	—	—	—

Note : The depth shows the tip of the egg pods which laid under ground, and the temperature after parasitization was recorded with the self-recording thermometer.

As is seen in Table 3, both the species will force their way through about 1cm of loose soil for attacking the host eggs and they are also successfully parasitized to above half of the treated egg pods.

The results of the investigations on the relation between the treated conditions of the egg pods and the finding of the parasites are shown in Table 4. And in case of this investigations, 14 females of *Scelio muraii* and 20 females of *S. tsuruokensis* were liberated in each glass jar.

Table 4

The relation between the treated conditions of egg pods and the finding of *Scelio muraii* and *S. tsuruokensis*

Sp. \ Item	Treated conditions of egg pod	No. of treated	No. of parasitized	Ratio of do (%)	Date of parasitized	Date of emerged
Scelio muraii	Non-treated (Check)	7	7	100.0	July 27, 1957	Aug. 29, 1957
	Wrapped in Japanese writing paper	5	0	—	—	—
	Wrapped in transparent paper	5	0	—	—	—
	Removed the corky substance	30	0	—	—	—
S. tsuruokensis	Non-treated (Check)	7	7	100.0	Aug. 14, 1957	Sept. 27, 1957
	Wrapped in Japanese writing paper	5	0	—	—	—
	Wrapped in transparent paper	5	0	—	—	—
	Removed the corky substance	0	0	—	—	—

As is seen in Table 4, both the species pay no attention to the treated egg pods, *i. e.*, they never attacked those egg pods.

Consideration

1) The selection of the host

As is shown in Table 1, both the species were successfully parasitized only in genus *Oxya* eggs (pods), whereas they paid no attention to the eggs (pods) of other Acrididae insects. This fact is, it seems, due to the differences of the structure (physical and chemical composition) of each egg pod, *i. e.*, the egg pods of *Oxya japonica* and *O. velox* are resembled in structure and essentially differ from the other Acrididae egg pods.

As for the relation between an extent of the development of the host embryo and the selection of the parasites, the host eggs in all stages of the embryonal development except three days before emergence may be successfully parasitized by both the species.

But the duration becomes prolonged as the embryonal development of host was advanced (Table 2). It is conceivable that, this fact is due to the prevention of the development of the parasites with the advance of the development of the host eggs, *i. e.*, the physiological resistance of the host is increased.

In general, there is not much difference between the duration, when the host

eggs (similar in embryonal development) are parasitized at the same time and protected with the similar conditions (MURAI, 1957c, '58).

According to PEMBERTON (1933), *Scelio pembertoni* belonging to the same genus may be parasitized to the host eggs in all stages.

2) The finding of the host

As is shown in Table 3, both the species are capable to find the host eggs (pods) which laid under ground about 1 cm in depth, because they can get into the soil. On the other hand, the majority of egg pods which are seen in the field, were laid exposed or unexposed within the limits of about 0~2cm in depth, and in case of the latter, the tip of the egg pods near the earth's surface was slightly covered with the soft and crevice soil (MURAI, 1957d). Therefore, the majority of the egg pods which laid in the field from August to September (those periods agree with the period of the emergence of both the species) seem to be parasitized by both the species. This fact shows clearly in the percentage of the parasitism and the distribution pattern of the parasites in host eggs (MURAI, 1957b, '59).

The *Oxya* egg pods which laid under ground are clearly situated out of the visual sense of both the species. The author, therefore, had the interested investigations on the relation between the treated conditions of the egg pods and the finding of the parasites as shown in Table 4. But the treated egg pods, especially the egg grains completely removed of the corky substance, were not attacked by both the parasites in spite of the real host. This apparently indicates that, both the species are attracted not only by the eggs themselves, but by the chemical scent of the corky substance, *i.e.*, the foamy secretion of the accessory glands emitted during the oviposition.

According to the author's observations, both the species inserted their ovipositors in empty egg pods from which they emerged themselves or *Oxya* nymphs emerged and also harshly attacked the newly deposited egg pods than those of old.

Hence, the finding of the host seems to be primarily due to the olfactory sense, and secondarily to the visual, tactile and other senses.

Judging from the these facts, both the species are lacking in discrimination of the host eggs.

Summary

1) Both the species were successfully parasitized only in genus *Oxya* eggs, but they paid no attention to the eggs of the other Acrididae insects (cf. Table 1). This fact seems to be due to the differences of the structure of each egg pod, because the *Oxya* egg pods are essentially differ from the other Acrididae egg pods. Also, the host eggs in all stages of embryonal development except three days before emergence may be successfully parasitized by both the species, but the duration becomes prolonged as the embryonal development of the host advanced (cf. Table 2). It is

conceivable that, this fact is due to the prevention of the development of the parasites with the advance of the development of the host eggs.

2) Both the species were capable of finding the host eggs which laid under ground about 1 cm in depth (cf. Table 3). Those host eggs are clearly situated out of the visual sense. On the other hand, the treated eggs (pods), especially the egg grains completely removed of the corky substance, were not attacked by both the species in spite of the real host (cf. Table 4). This apparently indicates that, both the species are attracted not only by the eggs themselves, but by the chemical scent of the corky substance.

Then, the finding of the host seems to be primarily due to the olfactory sense, and secondarily to the visual, tactile and other senses.

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摘　　要

イナゴ卵寄生蜂に関する研究（第7報）
特に寄生蜂ムライクロタマゴバチ及びツルオカクロタマゴバチの
寄主選択と寄主発見について

村　井　貞　彰
（山形大学農学部応用動物学研究室）

1) 両卵寄生蜂ともイナゴ（Genus *Oxya*）の卵にのみ首尾よく寄生し（第1表），他のバッタ属卵には全く注意を払わない．これは寄主卵をつつむ卵塊構造の物理，化学的な差異にもとづくもののようである．

また，両卵寄生蜂とも寄主卵胚子の発育状態に関係なく寄生するが（第2表），イナゴ仔虫脱出直前の寄主卵からは寄生蜂の脱出は認められなかつた．一方，寄生蜂の脱出した寄主卵においては，寄主胚子の進んだ卵ほど，寄生してから成虫脱出までの所要日数が長引く傾向が認められた．

これは寄主胚子の発育にともなつて，寄生蜂の発育が阻害されるためと推察される．

2) 両卵寄生蜂とも地下 1cm 前後の深さまでは潜土して寄主卵を発見出来る（第3表）．この場合，寄主卵をつつむ卵塊は明らかに寄生蜂の視覚のおよばないところにある．

一方，卵塊をいろいろに処理した場合，卵塊を構成するコルク質状物質を取除いた卵粒は真の寄主であるにかかわらず，寄生蜂は全く注意を払わない（第4表及び第1図）．

この事実は，両卵寄生蜂が寄主卵それ自体に誘引されるのではなく，卵粒をつつむコルク状物質の化学的臭気に誘引されたものと考えられる．